A system for improving heart assessment before transplantation

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Popular science summary of the doctoral thesis *A Cyberphysical System for Donor Heart Assessment*, March 2024. The thesis can be downloaded from: http://www.control.lth.se/publications

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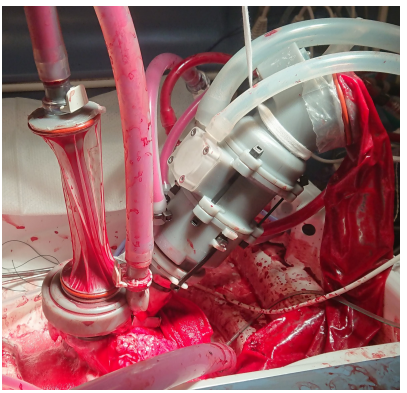
This research aims to improve the assessment of donor heart quality for transplantation to address the shortage of viable organs. Many donor hearts are currently discarded due to uncertainties about their condition, often related to oxygen deprivation. This deprivation can occur due to cardiac arrest in the donor, or during transport of the heart from the donor to the recipient.

Currently, there is no reliable method for assessing heart function after oxygen deprivation damage and prior to transplantation. Observing the heart under normal conditions, where it pumps blood against the body's resistance, is crucial for an accurate assessment. This can be achieved using an evaluation system where the heart beats against a mechanical resistance that mimics the body.



A resistance (right, grey), that imitates the body, is used to judge the heart's (bottom) pumping function under realistic conditions. Photo from Artificial Organs, Pigot et al, 2022].

The development of mathematical models and computer-based simulation tools that emulate the conditions a heart faces when pumping blood in the human body make up a central part of the thesis. Focus is also put on creating adjustable resistance devices that accurately replicate these conditions. Since all heart transplant patients are different, the devices are designed to adjust resistance to match a variety of potential recipients, while preventing harmful resistance levels. This is achieved through precise computer control, which continuously monitors the heart's condition and adjusts the resistance as needed. Beyond simulations, a version of the system with 3D-printed resistance devices are successfully demonstrated with pig hearts. This is an important step toward clinical implementation of the technology, where it can act as an important basis for decision-making that enables more safe transplants.